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ABSTRACT

This workbook is the third in a series of three that has been integrated into the chemistry curriculum for majors at the University of Vermont. The workbook consists of readings and exercises designed to provide undergraduate students with foundation skills in the use of professional literature. The major emphasis is on searching the literature for topics to be included in papers and seminar lectures. Areas discussed include: (1) problems due to the growth of scientific information; (2) literature reviews; (3) monographs; (4) the Science Citation Index; and (5) searching on-line databases in chemistry, focusing on search strategies and chemistry databases. A 6-item student evaluation sheet is included. (This workbook assumes that students are familiar with the printed indexes and abstracts of "Chemical Abstracts.") (JN)

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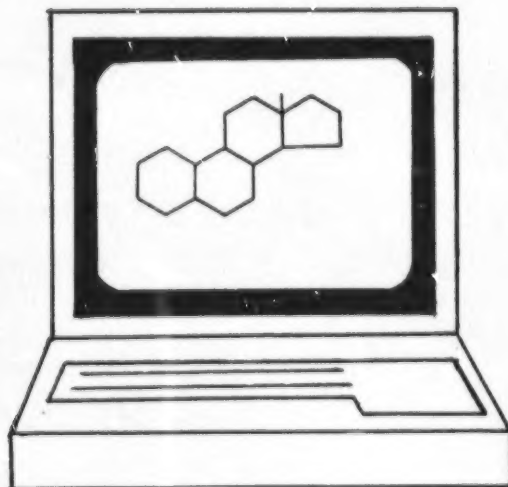
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THE SEMINAR PAPER:
STRATEGIES FOR THE LITERATURE SEARCH

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FOR: DR. C.H. BUSHWELLER

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THE SEMINAR PAPER
STRATEGIES FOR THE LITERATURE SEARCH

Conjugi carissimae

Dear Reader:

This workbook is the third in a series that we have integrated into the chemistry curriculum for majors at the University of Vermont in order to train undergraduates in the use of professional literature. They use it in preparation of papers and seminar lectures to students and faculty, which the chemistry program requires of all B.S.-track seniors. The topics often pertain to undergraduate research projects.

Like the earlier workbooks in this series, this one offers practice exercises, but a concept of search strategy is more important to its purpose, and the "Search Strategy Outline" is meant to facilitate a particular approach. This workbook assumes that students are familiar with the printed indexes of Chemical Abstracts.

Introductory Note to Students

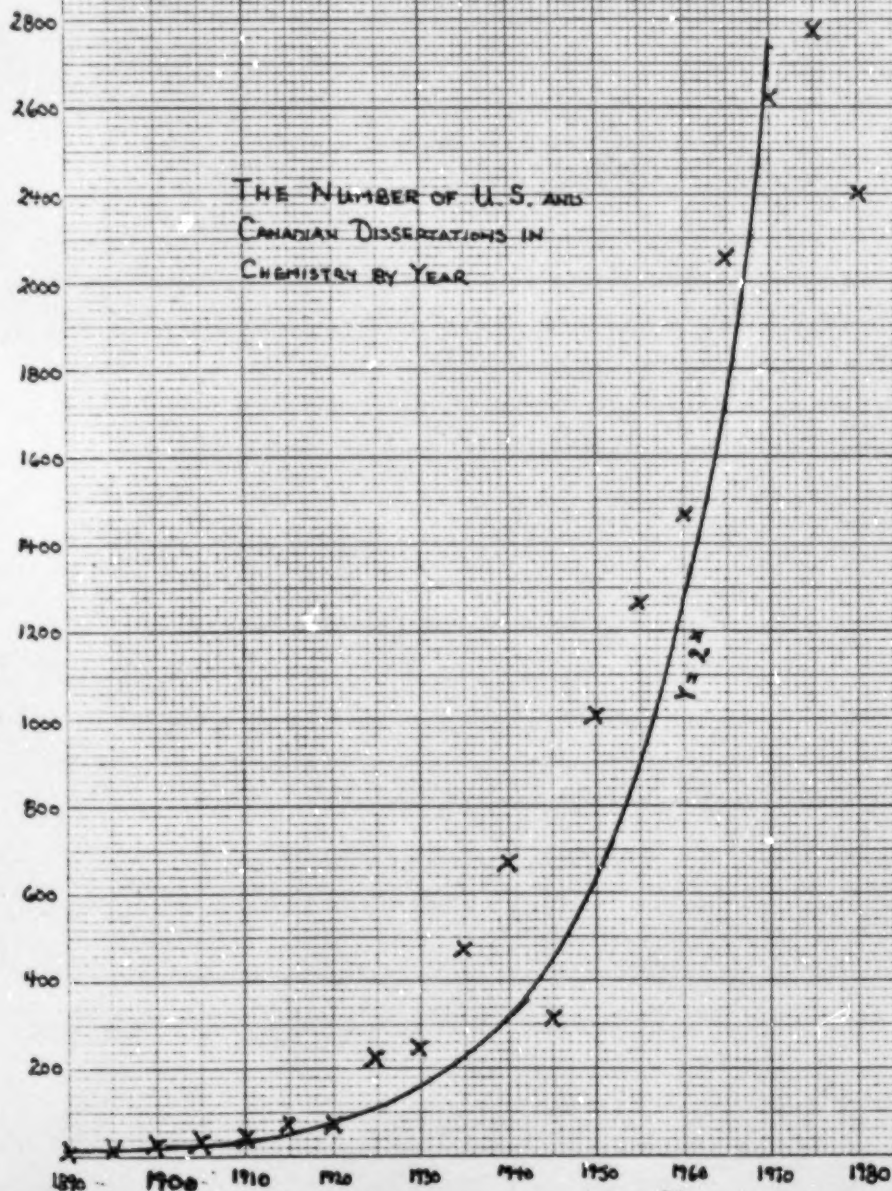
This workbook was prepared for the use of students in the Senior Seminar in Chemistry. It is meant to help ease you into serious scientific literature on topics of your own choice. It assumes that most undergraduates begin seminar papers by examining review literature on subjects of interest, and that this practice is not a mere expedient, but rather that you should be taught to use reviews as part of an effective literature searching strategy. It also introduces you to citation indexing and shows you how you can use the Science Citation Index to update reviews with more recently published information. The last section of the text presents a bare introduction to searching electronic databases in chemistry. A demonstration of these databases will follow during a regularly scheduled seminar meeting.

The workbook contains a few practice exercises scattered through the text. Do the exercises to make certain that you understand the material in the workbook. The concluding pages provide the outline of a literature search based on methods presented here. This workbook is the third in a series that began with An Introduction to Chemical Abstracts. It assumes that you have completed that workbook or that you have a secure knowledge of how the indexes and abstracts of Chemical Abstracts (CA) work together.

I: THE GROWTH OF SCIENTIFIC INFORMATION-- A DILEMA

If we measure science itself over a period of time, we discover an impressive fact. Whatever unit of measurement we chose -- whether it is the number of collegiate programs, or patents, or professional societies, or journal articles -- we usually find a geometric doubling pattern. By this we mean that units of any measure of science tend to double over equal units of time. The doubling time is longer for lower level measures (e.g., the number of freshman chemistry textbooks published) than it is for higher level measures (e.g., the number of microelectronic chips patented). But this general pattern has persisted since the Seventeenth Century, which is the earliest time for which we have good figures. If you wish to see such a measure of growth first hand, you can examine the number of papers abstracted in CA from one collective period to the next. Or look at the plot of American doctoral dissertations in chemistry, 1890-1980, on the following page. It shows the geometric pattern of growth in an eyeball sort of curve fitting. 1

1. The anomaly for 1945 is readily explained by World War II, which interrupted educations. The anomaly for 1980 is more interesting. It represents, among other circumstances, retrenchment in funding of higher education and a "glut" of young scholars with graduate degrees in all fields. Of course, nothing, not even graduate education in science, grows to the moon. But the momentum of science has lasted for so long, that we may suspect reports of its death are exaggerated.



Interesting corollaries follow from such growth. One is that most science that has ever been done (the area under the curve), has been accomplished during the lives of scientists now living. In fact, much of it has been done within your lifetimes. In that quantitative sense, science is very recent (though its roots are much older). Another implication, with practical meaning for us here, is that the documentation of scientific research accelerates. The literature on each subject branches and grows, and new journals appear every year. There are now some 100,000 scientific and technical journals in publication worldwide.

As the scientific "information explosion" has proceeded, professional society and commercial publishers have rushed to digital computers to help them prepare and print journals. Some science periodicals can now be read from computer terminals over phone lines even before they appear in print. Indexing and abstracting services, like Chemical Abstracts Service, need computers to collate and report news of recent literature in a timely way. The "machine-readable", or computerized, versions of their indexes and abstracts are also available to us over phone lines. We will take a closer look at such databases later in this workbook, and we will see a "live" demonstration of their features in a scheduled class period.

II: REVIEWS

The essential business of reading to keep up with one's field competes with research itself for a scientist's scarce time. In the two decades following World War II the documentation of science grew so vast that it was no longer possible for even conscientious scholars to keep abreast of the core literature of their disciplines. At about that time reviews came into popularity as a means of making this duty more manageable. Many review series date from about 1960, give or take a few years.

A review is a summary of the significant work that has been done in a given field of research within a specified period of time, which has bibliographic "references" to the original published research. As such, a good review article can save a scholar (or seminar student) hours of tedium trying to locate the original papers. He or she may use the "references" to find research literature that is of particular interest to a project. And because they help to define the significant trends in research and provide critical perspectives, reviews are of special value to anyone (read: student) whose experience in a field is limited. The reviewer makes explicit for us the principles or common themes that lie behind scattered pieces of research, so writing a review is a creative endeavor in itself. When you use a review, take care not to pirate this work. The seminar paper uses, but does not steal or seek to take credit for the reviewer's accomplishment. It is, in fact, a review effort in itself.

Reviews appear in a variety of scientific publications. Many mainstream research journals publish occasional review articles. But it is the specific function of review journals to devote themselves to this genre of literature. Review serials are a different in form, but not purpose. Serials resemble the journals that you are familiar with, in the sense that they are continuing publications, with dates and/or volume numbers and collective titles on their covers and spines. But they are published at less frequent intervals, typically one each year, and usually come bound in hard covers, so they resemble books to librarians, who usually catalog them and place them among the books in the library's collection. Nearly every science publishing company issues several such series. Many serials have titles such as "Annual Reviews in . . ." or "Progress in. . ." Some of them attempt to survey the work done year by year in a broad field of chemistry, such as medicinal chemistry. But most review serials devote their space to reports by known experts on "hot topics" of current interest, which change with each volume.

Here are some examples of the types of review publications in chemistry:

1. Research Journals That Publish Review Articles:

Journal of Organometallic Chemistry, 1963--
Angewandte Chemie, new series, 1947--
Analytical Chemistry, 1929--
Journal of the Less-Common Metals, 1947--

2. Review Journals:

Chemical Reviews, 1924--

Published by the American Chemical Society. Many papers are written at the invitation of the editors and are devoted to topics of current interest in pure chemistry. They are limited to topics that have not been reviewed in the last five years.

Accounts of Chemical Research, 1968--

Attempts to bridge the gulf between review journals and

reports of original research. Authors mix discussions of the literature with those of their own research.

Chemical Society Reviews, 1947--

Published by the London Royal Society of Chemistry, it presents topical articles that are of general interest to a wide audience of chemists.

3. Serials: Topics of Current Interests:

Advances in Inorganic and Radiochemistry

Each annual volume contains several extended reviews. Many have multiple authors.

Advances in Physical Organic Chemistry

Long, commissioned reviews on subjects of broad interest, such as "Chemiluminescence" or "Chemistry of Excited Complexes".

4. Serials- Comprehensive Annual Reports:

Annual Reports in Medicinal Chemistry

Provides annual updates of progress in drug research in chapters organized by therapeutic category, such as "Antineoplastic Agents". But also includes some variable chapters on topics of current interest in medicinal chemistry.

Nuclear Magnetic Resonance

One of the more than 35 series of "Specialist Periodical Reports" published by the Royal Society of Chemistry. A board of "reporters" (scholar experts) covers each year's work in such broad fields as "Applications of Nuclear Shielding" and "N.M.R. of Paramagnetic Molecules".

Obviously, reviews are of real value for you. But how can you locate them efficiently? There are several ways of finding reviews, and most of them involve the use of Chemical Abstracts.

1. You learned in an earlier workbook that the CA indexes place an "R" before every abstract number that denotes a review. So, you can find reviews by looking for the subject:

Pheromones, of insects
87: R 36104x

2. You also learned in that earlier workbook that the individual current issues of CA are divided into subject sections, such as: "79. Inorganic Analytical Chemistry" Each of these sections usually begins with abstracts of reviews. You can recognize these by the last sentence:

A review with # references

3. Each new weekly issue of CA also contains a "Keyword Index". Here you will find the keyword "review" followed by several columns of entries for the reviews abstracted that week.
4. We said earlier that many indexes now exist as "online" databases that we can access by computer. Chemical Abstracts indexes exist in such a machine-readable form back to 1967. The CA database is called CA Search. When searching it by machine (which we will discuss presently) it is possible to select reviews simply by using the term "review" in the identifier (ID) field. If a surrogate, such as a librarian, does the search for you, you may wish to offer this strategy as a suggestion:

Pheromones and Review/ID

5. There are a few indexes devoted exclusively to reviews. The Index to Scientific Reviews is published by the folks who give us Science Citation Index (of which, more follows). Unhappily, UVM does not receive this publication. But the Royal Society of Chemistry (Britain) publishes Index of Reviews in Organic Chemistry and Index of Reviews in Analytical Chemistry, both of which the Physics/Chemistry Library receives.
6. Above all, do not limit your horizons to reviews that you can pick off the shelves of the UVM libraries! You may ask the library to get your review(s) through Interlibrary Loan. Start early and budget extra weeks for this. You will discover in the future that corporate research and development libraries are even more dependent on borrowed materials than are academic institutions.

Exercise 1.

Look at the Keyword Index in the latest weekly issues of Chemical Abstracts. Can you find review articles on antitumor agents? If so, list the volume and abstract numbers of one or two of them.

ANSWER: _____

Exercise 2.

Find a review written in the last 5 years that deals with both N-14 and N-15 NMR studies of inorganic and bioinorganic systems. Give a citation for it.

ANSWER: _____

III: MONOGRAPHS

"Monographs", in the patois of librarians, are books, and as such they have call numbers, they can be found by using the card catalog, and they reside on the book shelves. But the simplicity is deceptive, because monographs may contain a variety of materials, from state-of-the-art "treatises" on particular subjects to the edited papers of scientific meetings. With the exception of the last category monographs do not serve the role in scientific communication of reporting the results of original research. So scholars often do not pay the same close attention to them that they do to journals. But most monographs do have value to you as students or as professional chemists because of their review character. A treatise, for example, usually reviews the entire development of its subject to date and describes its principles and methods. And it includes bibliographic references to research literature.

Be aware of these special difficulties in using "monographs":

1. Trying to find a monograph by subject in the card catalog can be vexing, because the "subject headings", or index terms, are usually not specific enough for the needs of chemists. You might, for example, be interested in "one-electron redox reactions of bimetallic organometallics", but in a card catalog you might have to settle for "Organometallic Compounds" or "Electrochemistry". When looking for books in the catalog, think of the broad subject.
2. Multi-authored monographs, such as the edited papers of scientific meetings, may also cause difficulties. The title of the publication itself is often problematic and the only "author" listed in the card catalog may, in fact, be the general editor. Don't conclude too quickly that the library doesn't own the publication. Be prepared to ask for help in finding it. Your best guide is probably Chemical Abstracts, which will index and abstract each paper in the volume separately.

3. Scholars learn to anticipate the arrival in the library of issues of their favorite journals, but books arrive at irregular intervals. And a busy scholar cannot keep track of what books his colleagues or the librarians are ordering. So books often arrive unheralded and are filed away on the library's shelves. Some libraries distribute an acquisitions list on (say) a monthly basis. The Physics/Chemistry Library at UMM does this. But you should recognize that you will have to accept much of the responsibility for knowing what books are available at your organization's library.

Exercise 3.

Consult the Library of Congress Subject Headings books (on top of the Card Catalog). What subject headings might you use to look for books on the biomimetic synthesis of indole alkaloids?

ANSWER _____

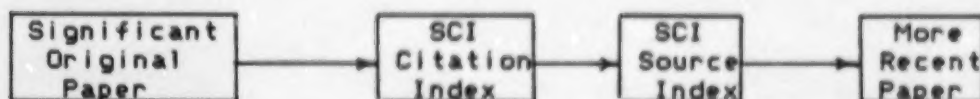
IV: SCIENCE CITATION INDEX

On the wall behind the librarian's desk at the Physics/Chemistry Library hang facsimiles of the manuscript and published versions of Avagadro's essay of 1811, on determining molecular weights of compounds from their densities as gases. His essay starts with a direct reference to Joseph Gay-Lussac's article, written three years earlier, on the "law of combining volumes". This is an early example of one of the cornerstones of scientific communication: the practice of citing earlier authorities. This custom of making explicit reference to earlier work on a research subject emerged as a norm of science in the Nineteenth Century. It is more than a polite habit. It is an obligation of all publishing scholars, which protects claims to priority and property rights, while permitting the open communication of research findings. It sets the contribution of each new research report in a context of scholarship, and so it gives coherence to science as a social enterprise.

Citation indexing uses networks of scholarly references to give us a unique and potent method for following the progress of scientific work. You know, of course, that you can look backward in time from a published paper by using its footnotes as a bibliography. But citation indexes allow you to look forward in time from a known piece of research. They work like this. Suppose that you are interested in the synthesis of insect pheromones. An important article on a new methodology -- our example is a major review, but you might choose a pioneering piece of original

research -- was published by John Katzenellenbogen in Science, (1976) 194, 139-48. Science Citation Index makes the assumption that scientists who cite Dr. K's article in subsequent years do so because they are interested in the same subject. It allows us to answer the questions: "who has cited Katzenellenbogen's article?" In other words it tells us who has extended this research.

Here is an illustration of the basic method:



1. Start with a significant research article or review on your topic. Notice that each year's volumes of Science Citation Index are a different color, and they consist of several separate parts: the Source Index, Citation Index, Permuterm Index and Journal Citation Reports. Starting with the year in which your article was published, or any subsequent year, look for the author in the Citation Index. Under the author's name you will probably see listed several of his/her articles. And under each of these you will find a list of authors (in tiny type) who cited the paper in that year. In the following example, from the 1975-79 collective Citation Index, we see that:

KATZENELLENBOGEN J

74	J AMER CHEM SOC	96	5663			
	WU A	TETRAHYDR L		1975	2057	75
75	BIOCHEMISTRY-US	14	1763			
	ARUNACHA.T	J BIOL CHEM		254	5900	79
	CHOWDHRY V	ANN R BIOCH	R	48	293	79
	HOCHBERG R	SCIENCE		205	1138	79
	KATZENEL.J	BIOCHEM		14	1736	75
76	SCIENCE	194	139			
	BAKER R	ANN RP CH B	R	74	367	77
	CLARK RD	SYN COMM		9	325	79
	DILLING WL	PHOTOCHEM P	R	25	605	77
	HENRICK CA	TETRAHEDRON		33	1845	77
	MANNERS IR	BOOK # 05912	R	1978	263	78

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Katzenellenbogen's 1976 review in Science was cited by R. Baker in 1977, by R.D. Clark in 1979, by W.L. Dowling in 1977, and so on.

2. The first citation listed, the article by Baker, turns out to be a special bonus -- another review, as the "R" indicates. To find a more complete bibliographic reference for it we turn to the Source Index. There we find

BAKER R

EVANS DA--BIOLOGICAL CHEMISTRY.2.INSECT CHEMISTRY
REVIEW

ANN RP CH B 72:367-391 77 253R
Univ. Southampton Dept.Chem, Southampton 509 5HH
Hampshire, ENGLAND

the name of a coauthor, the full title of the article, its pagination, the fact that it contains 253 references, and the address of the first author. Full titles of Journals (here the Annual Reports on the Progress of Chemistry, Section B--Organic Chemistry) and the titles of any citing books, which are identified by a BK#, appear at the beginning of the Source Index.

Science Citation Index is an ingenious aid to following the progress of a research topic in the sciences. But keep in mind a couple of mild reservations about using it. First, the postulate behind its method -- that if B cites A, then A and B are interested in the same topic -- is only a working hypothesis, which is not always a fact. B's paper may be of only peripheral interest to you, or A and B may only share a common interest in a laboratory method. Secondly, the index contains more than a few typographical and other errors. But with these reservations, it remains uncommonly useful to students of science.

The value of information to scientists (as measured by the practice of citation) diminishes over time in a rather predictable way. It may be said to "decay" as an exponential function. It

exhibits a "half-life", and a plot of it looks like the mirror image of the law of growth that we saw earlier.²

The half-life may be thought of as a measure of the continuing value of a publication to the scientific community over a period of time. Some types of publications, such as case studies in clinical medicine, have short half-lives, because they contain little that is of enduring value to a wide audience. Other publications have short half-lives because the fields of research to which they contribute are advancing at a very rapid pace. This is true, for example, of work in cell physiology, of nucleic acid investigations and of particle physics research. Such literature may have a half-life of only one or two years. Reviews, on the other hand, typically have a long useful life. The citation half-life of a good review usually exceeds ten years.

What that means practically is that if you can find a good review in a publication that is apt to be noticed by scholars in the field, you can use it to follow progress on the topic for a considerable time by using Science Citation Index. Reviews and citation indexes make natural complements for one another, and together they provide a good strategy for doing literature searches.

2. "half-life" is meant here only as a theoretical notion. Science Citation Index defines it empirically as the number of years, counting backward from the current year, that account for 50% or more of the total citation. Of course the "current" year changes, and so does the measured half-life.

Exercise 4. Using the Science Citation Index, which is located in the DANA MEDICAL LIBRARY, determine how many times Dr. Bushweller's article in the Journal of the American Chemical Society 1975, 97(1), 65-73 was cited between 1975 and 1979.

ANSWER: _____

How many of these citations were in reviews?

ANSWER: _____

In the Source Index find a full reference for the next-to-last of these citations.

ANSWER: _____

V. SEARCHING ONLINE DATABASES IN CHEMISTRY

A "database" is any group of records that contain data presented in an ordered fashion. Your checkbook register (we assume) can be considered a database. In current use, the term has come to mean records stored on magnetic media in machine-readable form. By the late 1950's the producers of large indexes and abstracts, like Biological Abstracts or Chemical Abstracts found it necessary -- from considerations of cost and timely publication -- to develop bibliographic databases for such in-house chores as collating, editing and printing of their publications. These house databases amounted to computerized versions of their printed products. With the development of interactive, time-sharing technology in the following decade, a possibility arose for the public to share this resource through computerized searching of the contents of these electronic versions of the indexes. This potential became commercial reality when certain private sector companies began to buy and lease tapes of the databases from their producers, to reformat them, to mount the information on their own hardware and to offer access to the public on a fee-paying basis. The oldest and largest of these commercial middlemen, DIALOG Information Systems (a division of Lockheed Corp.), began offering such a service in 1972. DIALOG and its competitors allow us, with only a modest investment in terminal hardware, to search by computer the contents of dozens of databases, including most of the major scientific indexes and abstracts.

Naturally, searching literature references by computer is quick and convenient, because the machine reads information at

electronic speeds. But more important are the great flexibility in formulating search queries and the increase in indexing points of access that the computer gives us.

To explore these possibilities let us compare the Chemical Abstracts indexes with their database sibling, CA Search. The printed indexes permit us essentially five points of entry to find chemical literature: the authors, general subjects, specific chemical substance names, specific molecular formulas, and dates (year or half-year). CA Search provides all of these and others, such as Journal titles, CA abstracts sections, registry numbers, keyword identifiers, languages of publication, patent numbers, and so on. We may also use any word or string of characters that might appear in a title as a search term. Further, we may mix these terms as sets in search expressions, which the indexers need never have envisioned. We may use the computer's Boolean AND, OR & NOT logic to combine sets. For example, we may ask CA Search for literature references to reviews(1) on the preparation(2) of pheromones(3). Notice that this search statement defines the coincidence of three sets: 1 AND 2 AND 3



In this example the computer will answer us with references to documents that are common to all three sets. We could qualify our search even more by asking, say, for only articles that are written in English OR German OR French after 1978 that are NOT

patents. Of course, the more qualifications we add, the fewer document references we will retrieve. This ability to tailor what the computer reports also lets us create some custom services. For example, we can ask the computer to run our queries automatically against the new records added to the database each month. Then we receive by mail from the vendor a monthly "current awareness" list, called, in the librarians' jargon, an "SDI" (for selective dissemination of information!). You will not need such a service as an undergraduate, but keep it in mind as an aid in your professional career in the Real World.

Computerized literature searching provides great flexibility, speed and specificity in finding scientific literature references. Its main drawbacks are the considerable cost of the service (especially royalties to the database producer) and the absence from most databases of literature older than the 1960's.

Most databases for chemistry are bibliographic --they provide us with references to chemical literature. They are often accompanied by "dictionary" files of chemical substances (with their many synonyms) and by special methods for searching by substructures (incomplete structures). Several databases are "numerical" or "non-bibliographic". These usually contain chemical and physical data, such as spectroscopic, thermodynamic, analytical, toxicological and crystallographic values. The growth of numerical data files has been slow, because of the doubtful value of much published experimental data, and because they were not built upon earlier printed works.

Of the dozens of databases that have utility for chemists, let us limit our discussion here to three particularly important clusters of files:

CA Search-- is created in machine-readable form by Chemical Abstracts Service and leased to several commercial vendors, who reformat it to make it compatible with their search systems. It corresponds to the indexing and bibliographic references of Chemical Abstracts, from 1967 to the present. DIALOG, the most heavily used version of CA Search, has supplemented it with several dictionary files of chemical substances, which allow us to find the formal names and registry numbers of chemicals by using name fragments, trivial names, ring data and molecular formulas. The registry numbers are particularly helpful for retrieving literature on specific chemical substances.

CAS Online-- this proprietary CAS database contains the Chemical Registry file of 4-7 million substances indexed in CA. The uniquely powerful feature of this database is the ability that it gives us to search the registry file by drawing substructures or structures -- with keyboard commands or by choosing structure fragments from a menu with a stylus and a graphics tablet. As chemists we communicate in a graphics language of structural symbols, which we are able to reduce to names only with some difficulty. Often, we are interested in a class of compounds that share a common substructure. The CAS Online software allows us to use the structural symbols themselves to search for chemical information. So it works as a diagram dictionary of chemical substances.

It answers queries about specific substances with their structural diagrams, names, synonyms, registry numbers and molecular formulas. It can also provide bibliographic references and abstracts from CA for literature on these substances.

CAS Online is an evolving service, which plans to become a kind of supermarket of chemical information. In late 1983 the entire contents of CA Search were added to this database. Chemical Abstracts Service is actively developing a file to provide reaction indexing. This function will allow us to find references to a specific type of reaction by telling the system such variables as reaction site (where a bond is formed or broken, as in Theilheimer's Synthetic Methods), catalysts, solvents or media, and the physical environment of temperature and pressure. This file will be of special value to chemists who are interested in preparative methods. Yet another enhancement planned for CAS Online is the inclusion of searchable "tags" to indicate the presence in documents of experimental data, such as spectra or melting points.

CAS ONLINE has a French rival, a service called DARC.

NIH/EPA Chemical Information System-- this family of databases, sponsored jointly by the National Institutes of Health and the U.S. Environmental Protection Agency, is not currently available at U.M. We mention it here as an example of the more specialized,

largely non-bibliographic databases. The Chemical Information System comprises a dozen small databases derived from various sources. At its center is the Structure and Nomenclature Search System (SANSS), a substance dictionary that can be searched by names, structural features and certain codes. The SANSS links to other databases by CAS registry numbers. The Mass Spectral Search System (MSSS) and Carbon-13 Nuclear Magnetic Resonance Spectral Search System (CNMR) contain spectral data. X-Ray Single Crystal Search System (XTAL) provides means for searching the National Bureau of Standards Crystal Data Determinative Tables. The Mathematical Modelling System (MLAB) is an interactive program for modelling by statistical and regression analysis, calculus and other methods. Federal Register Notices offers bibliographic access to regulation of chemical substances published in the Federal Register. And so on. Although they are expensive to build and maintain, "numerical" databases, like those of the Chemical Information System, will receive increased attention in the coming years.

The time may be approaching when chemists, the "end users" of chemical information, perform most of their own computer searches. But for reasons of economy and efficiency, most organizations still assign database searching responsibility to experienced surrogates, such as technical librarians. This division of labor offers the usual advantages of specialization. You can expect to find such persons in whatever institution you join. Whenever you request a database search, approach your interview with this surrogate as a chance to consult with him or her about your technical information needs in their entirety. Don't look on a computerized service either as a mere timesaver or as a talisman. Hand searching printed indexes still works nicely for many purposes.

VI

A science information industry and its field agents, technical librarians, are developing means to help you cope with the immense outpouring of documentation. Some of these methods, such as the review, have become traditional. Others derive from computer technologies. Because your success as a professional chemist will depend in part on keeping up with your field, you need to be at ease with the most efficient means of doing so. You should view literature searching as an essential set of career skills. The seminar paper gives you a chance to explore all of the methods presented in this workbook.

SEARCH STRATEGY OUTLINE

GIVE A TITLE TO YOUR SEMINAR TOPIC: _____

GIVE A CONCISE DESCRIPTION OF THE PROBLEM THAT YOU WILL ADDRESS:

LIST CHEMICAL ABSTRACTS GENERAL SUBJECTS, CHEMICAL SUBSTANCE NAMES AND KEY WORDS OR PHRASES THAT MIGHT HELP TO LOCATE LITERATURE REFERENCES IN THE INDEXES. TRY TO ORGANIZE THESE TERMS VERTICALLY INTO CONCEPTS. EACH CONCEPT MAY BE REPRESENTED BY SEVERAL SYNONYMS OR ALTERNATIVES:

Concept A

Concept B

Concept C

_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

LIST TITLES OF SOME SERIALS OR JOURNALS IN YOUR FIELD THAT MIGHT PUBLISH REVIEWS ON YOUR TOPIC. (IF YOU HAVE TROUBLE DOING THIS, CONSULT WITH YOUR ADVISOR OR WITH THE LIBRARIAN):

USING CHEMICAL ABSTRACTS TRY NOW TO LOCATE REVIEWS THAT WILL BE OF
HELP TO YOU IN THE PREPARATION OF YOUR SEMINAR TOPIC. LIST
BIBLIOGRAPHIC REFERENCES FOR THE REVIEWS:

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Article
Reference

Hoffman, Brian M.; Ibers, James A. Acc. Chem. Res.
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CA 87:21679 "Organic molecular crystals"

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